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| 10/658,285 | 09/10/2003 | Henry Berger | COE-575 | 2452 |

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| EXAMINER | |
|---|---|
| NEWMAN, MICHAEL A | |
| **ART UNIT** | **PAPER NUMBER** |
| 2609 | |

| SHORTENED STATUTORY PERIOD OF RESPONSE | MAIL DATE | DELIVERY MODE |
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**Please find below and/or attached an Office communication concerning this application or proceeding.**

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication.

| Office Action Summary | Application No. | Applicant(s) |
|---|---|---|
| | 10/658,285 | BERGER ET AL. |
| | Examiner | Art Unit |
| | Michael A. Newman | 2609 |

*-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --*

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

1)☒ Responsive to communication(s) filed on *19 December 2003*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

4)☒ Claim(s) *1 - 8* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1 - 8* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

**Application Papers**

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

## DETAILED ACTION

### *Claim Rejections - 35 USC § 102*

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

2. Claims 1 - 8 rejected under 35 U.S.C. 102(b) as being anticipated by Berger et al. (*Deconvolving Optical Sensor Image Distortion Using Hermite Functions* - SPIE Vol. 3753 – July 1999) hereinafter referred to as Berger.

a. Regarding claim 1, Berger teaches a process for deconvolving data collected by a device the point spread function response of which follows a Gaussian distribution, said process undertaken to accurately estimate actual parameters derivable from said data **(Section 1. Introduction; paragraph 9) [Berger teaches the use of the deconvolving method as means of extracting the "true" image captured by optical sensors and systems having PSFs characterized by Gaussian distribution]**, comprising: forming at least one mathematical relationship **(Equation 1a)** having a first mathematical equivalent of said data on one side of an equality **[M(z) is the measured image]** and a second mathematical equivalent of said parameters on the other side of said equality **[I(x) is the desired but initially unknown object image]**; selecting an order, m, of a Hermite function for modifying said at least one mathematical relationship **(Section 1. paragraph 2) [Berger proposes the use of 'nth' order**

**Hermite functions; furthermore, in the example contained in Section 5. the author arbitrarily selects a seven-term hermite function representation]**; modifying said mathematical relationship to form at least one Hermite function therein, wherein forming said at least one Hermite function permits identification of at least one like item, having a coefficient, on each side of said equality, said coefficients associated with said actual parameters being unknown **(Section 3. paragraph 1) [Note that equation 19 is the Right Hand Side of equation 1a and contains the Hermite expansion of the unknown coefficients, $I_n$.] (Section 3 part B. paragraph 1) [Note that the measured data, M(z)-the Left Hand Side of equation 1a, is re-written as M(R) and is expanded in a Hermite function series in equation 24]**; developing at least one set of linear equations from said mathematical relationship that relate to said coefficient of each said at least one like items **(Section 3 part C) [Following the derivation recited in Section 3 parts A and B, Berger develops a set of linear equations (equation 27) relating the coefficients $M_n$ and $I_n$ and hence the captured data, M(x), and the desired data, I(x).]**; solving said set of linear equations for said unknown coefficients, wherein solving said set of linear equations produces an exact solution to said convolution; and deconvolving said set of linear equations. **(Section 3 part C) [By inverting the set of equations (equation 27) Berger obtains equations expressing the unknown coefficients, $I_n$, in terms of the known measured data, $M_n$. Solving for $I_n$ produces I(x), the sought after deconvolution from the measured image.**

**Furthermore, once the unknown coefficients, $I_n$, have been found, equation 27 yields the results of the convolution]**

b. Regarding claim 2, Berger teaches the process of claim 1 **(as set forth in part *a* above)** in which said mathematical relationship is of the form:

$$D(z) = \int p(z-x)I(x)dx \quad \textbf{(Equation 1a)}$$

where: D(z)=said data **(M(z) is the measured image)**; I(x)=expression involving said parameters **(I(x) is the desired but initially unknown object image)**; and p(x) point spread function (PSF) representing response distribution of said device **(p(x) is the measured PSF of the optical system or instrument).**

$$Y_m = \int_{-\infty}^{\infty} e^{\frac{(z-x)^2}{2}} e^{\frac{x^2}{2}} H_m(x)dx$$

where: $Y_m$ is said data represented at least partially as a Hermite function said point spread function for said device is represented by $e^{\frac{z-x^2}{2}}$ **(Equation 2) [According to the discussion in Section 4 paragraph 3; if the PSF's peak is placed at the origin, the constant *d will become 0*, also for the case in which the peak height of the PSF is normalized to 1, the constant *b will be* $\frac{1}{2\pi}$, finally if the full with at half maximum (FWHM) of the PSF is $(2.355)^{-1}$, *a will be 1*. Equation 2 will reduce to** $e^{-\frac{x^2}{2}}$ ], said Hermite Function is represented by $e^{-\frac{x^2}{2}} H_m(x)$ **(Equation 3) [Section 3. paragraph 1 discusses the measured image representation by a Hermite function]**, and $H_m(x)$ is a

Hermite polynomial of order m **(Equation 4). [Note that the form of $Y_m$ is that of the convolution of the measured data expressed as a Hermite function and the Gaussian PSF of the device and is known in the art (Section 1. pargraph 7)]**

c. Regarding claim 3, Berger teaches the process of claim 1 **(as set forth in part *a* above)** initiating any conventional iterative deconvolution techniques to further refine said data, wherein fewer iterations will be needed as compared to conventional methods of deconvolution because of the accurate starting point provided by said process **(Abstract, last 4 lines)**.

d. Regarding claim 4, Berger teaches a process for deconvolving output from detectors, the point spread function response of said detectors following a Gaussian distribution, said process undertaken to accurately estimate environments derivable from said output **(Section 1. Introduction; paragraph 9) [Berger teaches the use of the deconvolving method as means of extracting the "true" image captured by optical sensors and systems having PSFs characterized by Gaussian distribution]**, comprising: forming at least one mathematical relationship **(Equation 1a)** having a first mathematical equivalent of said output on one side of an equality **[M(z) is the measured image]** and a second mathematical equivalent of said environments on the other side of said equality **[I(x) is the desired but initially unknown object image]**; selecting an order, m, of a Hermite function for modifying said equality, wherein, said order also determines the number of terms for the representation of said

environments **(Section 1. paragraph 2) [Berger proposes the use of 'nth' order Hermite functions; furthermore, in the example contained in Section 5. Berger arbitrarily selects a seven-term Hermite function representation]**; modifying said equality to form at least one Hermite function within the equality, wherein forming said Hermite function permits identification of at least one like item, having a coefficient, on each side of said equality **(Section 3. paragraph 1) [Note that equation 19 is the Right Hand Side of equation 1a and contains the Hermite expansion of the unknown coefficients, $I_n$.] (Section 3 part B. paragraph 1) [Note that the measured data, M(z)-the Left Hand Side of equation 1a, is re-written as M(R) and is expanded in a Hermite function series in equation 24]**; developing at least one set of linear equations from said equality that relate to said coefficient of each said at least one like items **(Section 3 part C) [Following the derivation recited in Section 3 parts A and B, Berger develops a set of linear equations (equation 27) relating the coefficients $M_n$ and $I_n$ and hence the captured data, M(x), and the desired data, I(x).]**; and solving said set of linear equations for said coefficient of each said like item, wherein solving said set of linear equations produces an exact solution to said convolution, in turn, permitting deconvolution using linear relationships. **(Section 3 part C) [By inverting the set of equations (equation 27) Berger obtains equations expressing the unknown coefficients, $I_n$, in terms of the known measured data, $M_n$. Solving for $I_n$ produces I(x), the sought after deconvolution from the measured image. Furthermore, once**

**the unknown coefficients, $I_n$, have been found, equation 27 yields the results of the convolution]**

e. Regarding claim 5, Berger teaches the process of claim 4 in which said mathematical relationship is of the form:

$$D(z) = \int p(z-x)I(x)dx \quad \textbf{(Equation 1a)}$$

where: D(z)=said output **(M(z) is the measured image)**; I(x)=said environments **(I(x) is the desired but initially unknown object image)**; and p(z-x)=a transformed function of the point spread function (PSF) representing response distribution of said device **(p(x) is the measured PSF of the optical system or instrument)**.

f. Regarding claim 6, Berger teaches the process of claim 4 initiating any conventional iterative nonlinear deconvolution technique to further refine said output, wherein fewer iterations will be needed as compared to conventional methods of deconvolution because of the accurate starting point provided by said process **(Abstract, last 4 lines)**.

g. Regarding claim 7, Berger teaches a process yielding accurate representations of actual image data by deconvolving image data collected by optical detectors, the point spread function response of said detectors following a Gaussian distribution **(Section 1. Introduction; paragraph 9) [Berger discusses the use of the deconvolving method as means of extracting the "true" image captured by optical sensors and systems having PSFs characterized by Gaussian distribution]**, comprising: establishing a first

mathematical relationship as a general optical convolution integral **(Equation 1a)** equating said actual image data **[M(z) is the measured image]** to said collected image data **[I(x) is the desired but initially unknown object image]**; selecting a Fourier-Hermite function **(Section 1. paragraph 2) [Berger proposes the use of 'nth' order Hermite functions. Note that in Section 2; equation 6 Berger teaches the use of *a Fourier type orthogonal expansion* using the Hermite function. The use of a Fourier-Hermite expansion would have been inherent to one of ordinary skill in the art since the orthogonal Hermite series expansion is also known as the Fourier-Hermite series expansion]**; employing a generating function for Hermite polynomials for expanding a Fourier-Hermite series of said Fourier-Hermite function **(Equation 15)** to establish a linear mathematical relationship between said actual and said collected image data **(Section 3; part A) [Note that equation 15 is used to establish an intermediate linear relation (Equation 23). Equation 23 is used in equations 26 and 27, linear relationships between the measured image (M) and the true image (I)]**; selecting an order, m, of said Fourier-Hermite polynomial, wherein, m also determines the number of terms to be used for the representation of said images **(Section 1. paragraph 2) [Berger proposes the use of 'nth' order Hermite functions; furthermore, in the example contained in Section 5. Berger arbitrarily selects a seven-term Hermite function representation]**; expanding said actual image data in said Fourier-Hermite form with unknown coefficients by employing a series of special transformations to

convert the side of said mathematical relationship representing the actual image to a Fourier-Hermite series **(Equation 19) [Note that the orthogonal expansion for an "arbitrary" function is recited in equations 12 and 13]**; expanding said collected image data with known coefficients in said Fourier-Hermite form **(Equation 24) [Again, note that the orthogonal expansion for an "arbitrary" function is recited in equations 12 and 13]**; equating said known and unknown coefficients of like terms on each side of the mathematical relationship to relate the coefficients of said actual and said collected image data **(Equations 26 and 27)**; selecting an algorithm represented by a set of linear equations **(Section 3 part C.) [Following the derivation recited in Section 3 parts A and B, Berger develops a set of linear equations (equation 27) relating the coefficients $M_n$ and $I_n$ and hence the captured data, M(x), and the desired data, I(x).]**; solving said linear equations exactly **(Section 3 part C)**, wherein using said process yields a form proportional to a Gaussian function times a power series that is defined with a finite number of terms and incorporates said unknown coefficients of said actual image data as presented in a Hermite function **(Equation 19) [Note that terms a, b and d are constants described Section 4]**, and wherein a solution in closed analytic form provides a satisfactory solution to said general definitional convolution integral without approximation **(Section 1; Paragraph 3)**; and performing an analytic deconvolution of said convolution equation by inverting said linear equations, wherein said analytic deconvolution yields a solution having acceptable error levels **(Section 3 part C) [By inverting the set**

**of equations (equation 27) Berger obtains equations expressing the unknown coefficients, $I_n$, in terms of the known measured data, $M_n$. Solving for $I_n$ produces I(x), the sought after deconvolution from the measured image. Furthermore, once the unknown coefficients, $I_n$, have been found, equation 27 yields the results of the convolution]**.

h. Regarding claim 8, Berger teaches the process of claim 7 initiating any conventional iterative deconvolution techniques to further refine said accurate representations, wherein fewer iterations will be needed as compared to conventional methods of deconvolution because of the accurate starting point provided by said process **(Abstract, last 4 lines)**.

***Conclusion***

3. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

a. Moody (U.S. Patent 5,761,346) teaches a method to restore a signal system such as images that have become distorted during acquisition, transmission or reception. Uses discrete orthogonal basis functions to represent signals in linear systems and extracts the desired data from the acquired data by finding an inverse solution. Includes Hermite functions among others as possible orthogonal set functions.

b. Alon et al. (U.S. Patent 7,065,256 B2) teaches a method to process distorted images using a deconvolution filter (1/ PSF).

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Michael A. Newman whose telephone number is (571)-270-3016. The examiner can normally be reached on Mon - Thurs from 8:30am to 6:00pm (EST).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Ricky Ngo can be reached on (571)-272-3139. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

M.A.N.

Ricky Ngo
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SUPERVISORY PATENT EXAMINER